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# AUDITORY MEMORY

By CARL E. SEASHORE

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In the interest of guidance in music a series of psychological tests is being introduced in the public schools as an integral part of the music course in the fifth grade for the purpose of securing a survey of musical talent. Among these tests are measurements of the sense of pitch, sense of time, sense of intensity, sense of consonance, and auditory memory.

The last named test is herewith presented first to the music supervisors of the country, not because it is the most significant but because it requires no apparatus beyond the piano. In other respects it is characteristic of the other tests of the series

There is no one test for memory that is all-comprehensive because memory capacity varies with content of impression, conditions of impression, time of retention, accuracy of recall, ease of recall, serviceableness, and numerous other factors which may be isolated in measurement.

In general, memory tests may aim at one of three objects; first, the determination of natural capacity for a particular content, as in the test here described; second, the test of acquired skill, such as the rendering of repertoire, or the possession of absolute pitch; and, third, the power of learning, determining the rate and effectiveness of capacity for learning.

There are two general methods employed. In the method of reproduction, the observer is required to sing or play or otherwise produce or designate the thing that is remembered; by the method of identification he is simply required to identify memory objects which are presented. The latter is the method here followed because it is by far the most accurate as well as the best adapted for our purpose.

A test which shall be equally fair to young and old, trained and untrained and shall serve as a single test indicative of natural capacity for memory cannot be a test of special skill. It must employ material which is equally new to all in so far as that is possible—material which may be analyzed, described, varied under control, and repeated so that norms may be established.

Everything taken into account, the best single and fundamental test of capacity for a musical memory that we have been able to devise is the test of memory span here described.

The material to be memorized is furnished in Table I, in which letters are substituted for the musical notation in the interest of economy in printing. The experimenter will find it worth while to transcribe it into musical notation. These notes should be played in the octave *c' c''* on the piano using the soft pedal. The highest note, *c''* is not used. There are five degrees of difficulty represented by the five spans. The notes before the colon are called the "first part", and the notes after the colon the "second part", of a given trial. The second part is always like the first except in one note, and the test consists in identifying the note that is changed. The child records 1, 2, 3, etc., according as it is the first, sec-

ond, third, etc., note that was changed. The notes should be played smoothly, holding the sound of each note about one second and allowing a sixteenth pause between the notes in each part, and a pause of two seconds at the colon, to separate the two parts.

The pupil is supplied with a mimeographed or printed blank with cross ruling, the headings showing the title of the test, the name of the pupil, the initials of the experimenter, the date and hour, the grade, the age, and the school. The blank should have one column for each of the five spans, headed, respectively, two span, three span, four span, five span, and six span; at the left hand side should be the numbers from one to thirty.

To simplify the checking of the record, prepare a matrix by cutting out from the record blank a slit between each column at which the children's records are made and write on the margin of these openings the figures which denote the right answer. To read a record then, lay this matrix over the child's record and run down the column for a given span at a glance and simply check and count all mistakes and place the footing at the bottom of each column. Add these five footings together, subtract the sum from the total number of trials, and find what per cent. the remainder is of the whole number of trials. This is the per cent. of right

TABLE I

"s" is used to indicate sharp, thus in the first example "CsG" means C sharp and G.

2 SPAN	3 SPAN	4 SPAN
1. CsG : D G	G F B : G FsB	D F A G <sup>s</sup> : D F A G
2. F A : E A	CsG Ds : D G Ds	D A E Ds : D A <sup>s</sup> E Ds
3. A <sup>s</sup> G : B G	FsAsC : F AsC	G D <sup>s</sup> E C : G <sup>s</sup> D <sup>s</sup> E C
4. C D <sup>s</sup> : C D	E F C : DsF C	G D A B : G C <sup>s</sup> A B
5. B F : B Fs	F FsE : F G E	G E D B : G E D <sup>s</sup> B
6. E G : DsG	B A Gs : B A G	A F D <sup>s</sup> G : A F D <sup>s</sup> F <sup>s</sup>
7. C G <sup>s</sup> : C A	FsD B : FsDsB	A E G F <sup>s</sup> : A <sup>s</sup> E G F <sup>s</sup>
8. D <sup>s</sup> F <sup>s</sup> : D <sup>s</sup> G	G GsCs : G GsC	D <sup>s</sup> E G <sup>s</sup> A : D <sup>s</sup> E G A
9. A <sup>s</sup> D <sup>s</sup> : B D <sup>s</sup>	B F Fs : AsF Fs	F A D <sup>s</sup> D : F G <sup>s</sup> D <sup>s</sup> D
10. B F : B Fs	D GsG : D GsFs	A F C C <sup>s</sup> : A F <sup>s</sup> C C <sup>s</sup>
11. F <sup>s</sup> D : G D	B D C : B CsC	B A F <sup>s</sup> D <sup>s</sup> : B A G D <sup>s</sup>
12. E C <sup>s</sup> : B C	CsFsA : CsF A	A B F <sup>s</sup> F : A <sup>s</sup> E F <sup>s</sup> F
13. A D : G <sup>s</sup> D	G A B : G AsB	B F D <sup>s</sup> C : B F E C
14. D F : CsF	F C Ds : F C E	G F B A : G F <sup>s</sup> B A
15. A G <sup>s</sup> : A G	B A Gs : B A G	E A D C : E A D <sup>s</sup> C
16. G F : G E	F CsE : F D E	D F A G <sup>s</sup> : D F A G
17. B F : B Fs	E F C : DsF C	G E D B : G E D <sup>s</sup> B
18. B C <sup>s</sup> : B C	G F B : G FsB	A F D <sup>s</sup> G : A F D <sup>s</sup> F <sup>s</sup>
19. A <sup>s</sup> G : B G	B D C : B CsC	A B F <sup>s</sup> F : A <sup>s</sup> B F <sup>s</sup> F
20. E B : FsB	CsG Ds : D G Ds	B F D <sup>s</sup> C : B F E C
21. F D <sup>s</sup> : F D	FsDsC : F DsC	F A D <sup>s</sup> D : F G <sup>s</sup> D <sup>s</sup> D
22. G As : G A	G GsCs : G GsC	A F C C <sup>s</sup> : A F <sup>s</sup> C C <sup>s</sup>
23. A Ds : B Ds	F C Ds : F C E	E A D C : E A D <sup>s</sup> C
24. F <sup>s</sup> D : G D	CsFsA : CsF A	G D A B : G C <sup>s</sup> A B
25. A G <sup>s</sup> : A G	G A B : G AsB	A E G F <sup>s</sup> : A <sup>s</sup> E G F <sup>s</sup>
26. C G <sup>s</sup> : C A	B F Fs : AsF Fs	G D A B : B C <sup>s</sup> A B
27. FsAs : F As	F CsE : F D E	G D <sup>s</sup> E C : G <sup>s</sup> D <sup>s</sup> E C
28. D <sup>s</sup> F <sup>s</sup> : D <sup>s</sup> G	FsD B : FsDsB	B A F <sup>s</sup> D <sup>s</sup> : B A G D <sup>s</sup>
29. A <sup>s</sup> D : A D	D GsG : D GsFs	D A E Ds : D A <sup>s</sup> E D <sup>s</sup>
30. C G : C Fs	E FsE : F G E	D <sup>s</sup> E G <sup>s</sup> A : D <sup>s</sup> E G A

5 SPAN	6 SPAN
1. F D <sup>s</sup> G B F <sup>s</sup> : F D <sup>s</sup> G <sup>s</sup> B F <sup>s</sup>	D <sup>s</sup> B C <sup>s</sup> G D F <sup>s</sup> : D <sup>s</sup> A <sup>s</sup> C <sup>s</sup> G D F <sup>s</sup>
2. A G <sup>s</sup> F G D : A G <sup>s</sup> F G D <sup>s</sup>	C <sup>s</sup> D D <sup>s</sup> B F <sup>s</sup> A : C <sup>s</sup> D D <sup>s</sup> A <sup>s</sup> F <sup>s</sup> A
3. C F <sup>s</sup> F E A : C G F E A	A <sup>s</sup> G C <sup>s</sup> B G <sup>s</sup> F <sup>s</sup> : A <sup>s</sup> G C <sup>s</sup> B G <sup>s</sup> F
4. B E F D D <sup>s</sup> : A <sup>s</sup> E F D D <sup>s</sup>	A <sup>s</sup> B G <sup>s</sup> D <sup>s</sup> F <sup>s</sup> F : A B G <sup>s</sup> D <sup>s</sup> F <sup>s</sup> F
5. D <sup>s</sup> G E G <sup>s</sup> C : D <sup>s</sup> G E A C	E C F A G F <sup>s</sup> : E C F A G <sup>s</sup> F <sup>s</sup>
6. A D C B A : A D C <sup>s</sup> B A	B D <sup>s</sup> G C A <sup>s</sup> F <sup>s</sup> : B D <sup>s</sup> G <sup>s</sup> C A <sup>s</sup> F <sup>s</sup>
7. F D A G B : F D <sup>s</sup> A G B	B D <sup>s</sup> E F <sup>s</sup> A G <sup>s</sup> : B D <sup>s</sup> E G A G <sup>s</sup>
8. F E D A <sup>s</sup> G <sup>s</sup> : F E D A <sup>s</sup> G	A D <sup>s</sup> C E G B : A D C E G B
9. D G F G <sup>s</sup> A : D <sup>s</sup> G F G <sup>s</sup> A	G <sup>s</sup> G B D D <sup>s</sup> C : G <sup>s</sup> G A <sup>s</sup> D D <sup>s</sup> C
10. A E F F <sup>s</sup> C : A E F G C	D <sup>s</sup> G F <sup>s</sup> A <sup>s</sup> A E : D G F <sup>s</sup> A <sup>s</sup> A E
11. G E A <sup>s</sup> C F : G D <sup>s</sup> A <sup>s</sup> C F	D E A <sup>s</sup> F F <sup>s</sup> G <sup>s</sup> : D E A <sup>s</sup> F G G <sup>s</sup>
12. D <sup>s</sup> C <sup>s</sup> F A <sup>s</sup> A : D <sup>s</sup> C <sup>s</sup> F <sup>s</sup> A <sup>s</sup> A	A E F G <sup>s</sup> D B : A E F G <sup>s</sup> D A <sup>s</sup>
13. A <sup>s</sup> G B E C <sup>s</sup> : A <sup>s</sup> G B D <sup>s</sup> C <sup>s</sup>	F <sup>s</sup> B C <sup>s</sup> E G F : F <sup>s</sup> B D E G F
14. F E C <sup>s</sup> D <sup>s</sup> G : F <sup>s</sup> E C <sup>s</sup> D <sup>s</sup> G	A B D <sup>s</sup> F A <sup>s</sup> G <sup>s</sup> : A B D <sup>s</sup> F <sup>s</sup> A <sup>s</sup> G <sup>s</sup>
15. F E D <sup>s</sup> A G <sup>s</sup> : F E D A G <sup>s</sup>	G G <sup>s</sup> C A C <sup>s</sup> E : G G <sup>s</sup> C A D E
16. A E F F <sup>s</sup> C : A E F G C	A D <sup>s</sup> C E G B : A D C E G B
17. A D C B A : A D C <sup>s</sup> B A	E C F A G F <sup>s</sup> : E C F A G <sup>s</sup> F <sup>s</sup>
18. B E F D D <sup>s</sup> : A <sup>s</sup> E F D D <sup>s</sup>	A E F G <sup>s</sup> D B : A E F G <sup>s</sup> D A <sup>s</sup>
19. A G <sup>s</sup> F G D : A G <sup>s</sup> F G D <sup>s</sup>	G <sup>s</sup> G B D D <sup>s</sup> C : G <sup>s</sup> G A <sup>s</sup> D D <sup>s</sup> C
20. D <sup>s</sup> C <sup>s</sup> F A <sup>s</sup> A : D <sup>s</sup> C <sup>s</sup> F <sup>s</sup> A <sup>s</sup> A	A B D <sup>s</sup> F A <sup>s</sup> G <sup>s</sup> : A B D <sup>s</sup> F <sup>s</sup> A <sup>s</sup> G <sup>s</sup>
21. F D A G B : F D <sup>s</sup> A G B	D <sup>s</sup> B C <sup>s</sup> G D F <sup>s</sup> : D <sup>s</sup> A <sup>s</sup> C <sup>s</sup> G D F <sup>s</sup>
22. D G F G <sup>s</sup> A : D <sup>s</sup> G F G <sup>s</sup> A	A <sup>s</sup> B G <sup>s</sup> D <sup>s</sup> F <sup>s</sup> F : A B G <sup>s</sup> D <sup>s</sup> F <sup>s</sup> F
23. A <sup>s</sup> G B E C <sup>s</sup> : A <sup>s</sup> G B D <sup>s</sup> C <sup>s</sup>	D E A <sup>s</sup> F F <sup>s</sup> G <sup>s</sup> : D E A <sup>s</sup> F G G <sup>s</sup>
24. C F <sup>s</sup> F E A : C G F E A	A <sup>s</sup> G C <sup>s</sup> B G <sup>s</sup> F <sup>s</sup> : A <sup>s</sup> G C <sup>s</sup> B G <sup>s</sup> F
25. F D <sup>s</sup> G B F <sup>s</sup> : F D <sup>s</sup> G <sup>s</sup> B F <sup>s</sup>	B D <sup>s</sup> E F <sup>s</sup> A G <sup>s</sup> : B D <sup>s</sup> E G A G <sup>s</sup>
26. F E D A <sup>s</sup> G <sup>s</sup> : F E D A <sup>s</sup> G	F <sup>s</sup> B C <sup>s</sup> E G F : F <sup>s</sup> B D E G F
27. F E D <sup>s</sup> A G <sup>s</sup> : F E D A G <sup>s</sup>	D <sup>s</sup> G F <sup>s</sup> A <sup>s</sup> A E : D G F <sup>s</sup> A <sup>s</sup> A E
28. D <sup>s</sup> G E G <sup>s</sup> C : D <sup>s</sup> G E A C	G G <sup>s</sup> C A C <sup>s</sup> E : G G <sup>s</sup> C A D E
29. F E C <sup>s</sup> D <sup>s</sup> G : F <sup>s</sup> E C <sup>s</sup> D <sup>s</sup> G	B D <sup>s</sup> G C A <sup>s</sup> F <sup>s</sup> : B D <sup>s</sup> G <sup>s</sup> C A <sup>s</sup> F <sup>s</sup>
30. G E A <sup>s</sup> C F : G D <sup>s</sup> A <sup>s</sup> C F	C <sup>s</sup> D D <sup>s</sup> B F <sup>s</sup> A : C <sup>s</sup> D D <sup>s</sup> A <sup>s</sup> F <sup>s</sup> A

cases. Write the per cent. upon the page. Then turn to Table II for the appropriate group and find what percentile rank this would yield, *e. g.*, 84% right gives a rank of 84 for an adult, 90 for a seventh grade pupil, or 96 for a fifth grade pupil. This is the final record which is to be interpreted to the pupil. It shows what rank a person holds in a normal community of his age. Thus, the best in a community will rank 100 and the poorest will rank 1, and the average will be 50. The records of all our tests are interpreted on this scale which is simple and significant. This norm has been worked out on a large number of cases and will tend to become more smooth as larger numbers of records accumulate.

Require the pupils to keep their eyes closed while listening and to sit in an attitude of tension with a pencil placed for recording. Teach them the advantage of counting mentally 1, 2, etc. in the first part and in the second part so that they may identify by number the note changed as the notes are sounded. Do not allow anyone to record until the whole part has been sounded. Take precautions against copying from neighbors. Stimulate an attitude of interest. Charge the class to maintain highest effort. Stand up in an attitude of suspense with every look and gesture serving as a whip to the highest exertion. Let an assistant play the notes, taking care not to emphasize the changed note in any way. Allow suitable periods of rest—a short period after five trials and a longer period

after twenty-five trials—during which items of interest in regard to the significance of the test may be introduced. If the music period is a half hour use two periods on different days for the giving of the test, and count the records of the two periods as one.

Divide the trials into blocks of five as follows: first, five trials on each of the five spans from the shortest to the longest; then another group of five, and so on taking as many trials as the time will permit. Not less than one hundred and fifty trials should be required for a record for the two half hour periods. If more than one hundred and fifty trials are given use the same material, Table I, again.

TABLE II  
MEMORY — PERCENTILE RANK TABLE

% Right	% Rank			% Right	% Rank		
	Adult	7th-8th	5th-6th		Adult	7th-8th	5th-6th
100 : 100 — 100 — 100				64 : 52 — 50 — 68			
99 : 100 — 100 — 100				63 : 50 — 48 — 65			
98 : 98 — 100 — 100				62 : 48 — 46 — 61			
97 : 97 — 100 — 100				61 : 46 — 44 — 61			
96 : 96 — 100 — 100				60 : 44 — 42 — 57			
95 : 95 — 100 — 100				59 : 42 — 40 — 53			
94 : 94 — 100 — 100				58 : 40 — 38 — 49			
93 : 93 — 100 — 100				57 : 38 — 36 — 45			
92 : 92 — 99 — 100				56 : 36 — 34 — 41			
91 : 91 — 98 — 99				55 : 34 — 32 — 38			
90 : 90 — 98 — 99				54 : 32 — 30 — 36			
89 : 89 — 97 — 98				53 : 30 — 28 — 34			
88 : 88 — 95 — 98				52 : 28 — 26 — 32			
87 : 87 — 94 — 97				51 : 26 — 24 — 30			
86 : 86 — 93 — 97				50 : 24 — 22 — 28			
85 : 85 — 92 — 96				49 : 22 — 20 — 26			
84 : 84 — 90 — 96				48 : 20 — 19 — 24			
83 : 83 — 88 — 95				47 : 18 — 18 — 22			
82 : 82 — 86 — 95				46 : 16 — 16 — 20			
81 : 81 — 84 — 94				45 : 15 — 15 — 18			
80 : 80 — 82 — 94				44 : 14 — 14 — 16			
79 : 79 — 80 — 93				43 : 13 — 13 — 14			
78 : 78 — 78 — 93				42 : 12 — 12 — 12			
77 : 77 — 76 — 92				41 : 11 — 11 — 11			
76 : 76 — 74 — 91				40 : 10 — 10 — 10			
75 : 74 — 72 — 90				39 : 9 — 9 — 9			
74 : 72 — 70 — 89				38 : 8 — 8 — 8			
73 : 70 — 68 — 87				37 : 7 — 7 — 7			
72 : 68 — 66 — 85				36 : 6 — 6 — 6			
71 : 66 — 64 — 83				35 : 5 — 5 — 5			
70 : 64 — 62 — 81				34 : 4 — 4 — 4			
69 : 62 — 60 — 79				33 : 3 — 3 — 3			
68 : 60 — 58 — 77				32 : 2 — 2 — 2			
67 : 58 — 56 — 75				31 : 1 — 1 — 1			
66 : 56 — 54 — 73							
65 : 54 — 52 — 71							

The distribution of abilities is shown in Fig. 1, in which the first ten of the divisions represent the average per cent. of right cases and the second the average span that would yield 75% right judgments at the respective levels.

The ogive in Fig. 2 is a graphic representation of Table II showing how, by direct inspection, a given per cent of right cases may be converted into a percentile rank on any of the three norms. Thus, taking the record, 84% right as above, the percentile ranks, 84, 90, 96, may be

seen by inspection of the curve, the only object of the curve being to show in a graphic way the significance of the table.

The most striking result of this test is that a span of 6 is difficult enough for practically all of a normal community. A person who, in an extended series of trials, is able to get all records right would have an extraordinary capacity for this kind of memory. Other things being equal,

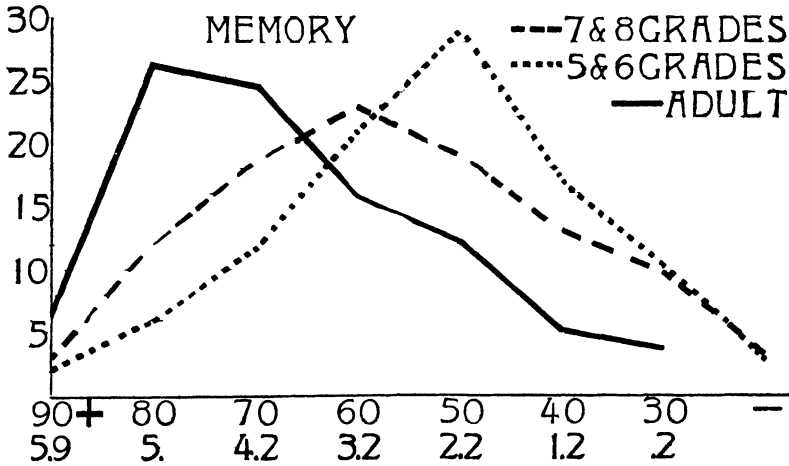


Fig. 1.

the child in the fifth grade room who ranks 85 gives promise of a memory for as extensive a repertoire as any musician may need, and persons who now play programs of several hours entirely from memory may not rank higher than 90 on this scale.

Another very surprising thing in the records is the number of bright pupils who fall down even on the two and three span, showing that ordinary memory of this kind does not correlate very closely with general ability in school work. In the personal interpretation of these records one should, however, take the general intelligence into account because,

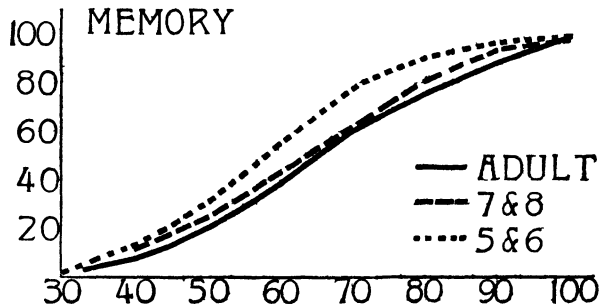


Fig. 2.

other things being equal, a dull person is likely to be handicapped so that the spontaneous exercise of memory in music might be better than the record here shows.

As to the reliability of the test, it may be said in general that the good records are probably reliable because they represent actual achievement. Ordinarily the upper half of the records should be considered en-

tirely trustworthy. In the lower half we find a variety of cases, *e. g.*, those who lack general power of mental application in sustaining effort, those who may have been disturbed by something occurring in the room, those who may have been lacking in serious effort throughout the test, and possibly others which might be isolated so that in most cases of importance the pupil with poor record should be given an individual trial or trial in small groups in which it is possible to verify the record or isolate the sources of error.

Memory is capable of cultivation on a large scale. It is safe to say that the memory skill of anyone in the plastic period might be increased at least ten-fold, but the significance of records of this kind comes from the fact that they are marks of natural capacity. They show with what sort of raw material the memory training starts. The improvement will be roughly proportional to the original capacity; *e. g.*, if we have the capacities represented by the 10%, 50%, and 90% ranks respectively in three cases, the improvement is not going to make them any more alike than they now are. Other conditions being equal, one will acquire a 10% skill, another a 50% skill, another a 90% skill according to the capacity that they now have.

No vocational guidance in music should be based upon this test alone, and conclusions as to ability must be limited to the factors under control, namely, immediate memory for unrelated tones.

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## The School and Community Christmas

By EDGAR B. GORDON.

*The University of Wisconsin, Madison.*

The Music Supervisor finds an increasing need for material of a seasonal character that offers opportunity for effective correlation with other branches of the school curriculum.

At this time when the spirit of patriotism and service is sweeping over us, with community, state, and national cooperation developing on every hand, there is nothing which will stimulate and weld into a better understanding the various elements and provide a wholesome outlet for the feelings of the community as do the arts of music and drama.

To aid in stimulating and maintaining the normal poise of community life so necessary in these trying times, it would seem to be peculiarly fitting that we observe the Christmas time in some such manner as to emphasize its spiritual significance and provide opportunity for its community expression.

The following list of material is given in the hopes of providing a suitable medium for the accomplishment of this purpose:

**THE NATIVITY:** DOUGLAS HYDE.—A very beautiful short Christmas play published in a volume entitled *Poets and Dreamers*, by Lady Gregory, now out of print. Fortunately, however, a copy of the play may be found in most libraries.